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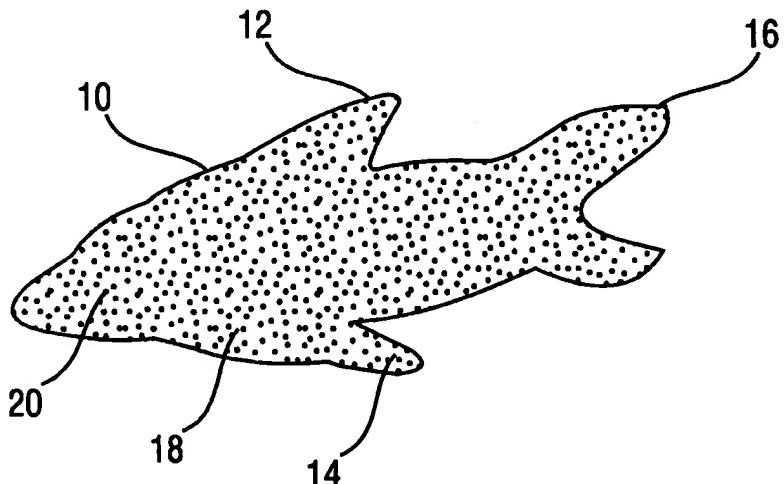
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(71) Applicant:	IMMUDYNE, INC. [US/US]; 11200 Wilcrest Green Drive, Houston, TX 77042 (US).	
(72) Inventors:	DUGGER, Durwood, M.; 5618 N. Old Dixie Highway, Fort Pierce, FL 34946 (US). WOOD, James, D.; Avenida Ntra Sra del Vinyet, 30, E-08870 Sitges (ES).	
(74) Agent:	GOODMAN, Kenneth, D.; Arnold, White & Durkee, P.O. Box 4433, Houston, TX 77210-4433 (US).	

## (54) Title: GEL DELIVERY SYSTEM FOR ANIMAL NUTRITION AND HEALTH

## (57) Abstract

A manufactured animal food article (10) contains (a) at least one edible component (20) including animal nutritional materials, animal immune system stimulants, animal appetite stimulants, animal color enhancers, or animal therapeutic agents; and (b) an edible gel carrier matrix (18). The edible component (20) is dispersed in the edible gel carrier matrix (18). The gel carrier matrix (18) preferably forms a continuous phase throughout the food article (10), with the other components (20) forming a discontinuous phase dispersed throughout the gel carrier matrix (18). The food article (10) can have the shape and/or scent of a naturally-occurring food item, either plant or animal, that would normally be eaten by an animal. The specific gravity of the food article (10) can be adjusted to exhibit approximately the same buoyancy in water of a naturally-occurring food item that would normally be eaten by the animal.



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## GEL DELIVERY SYSTEM FOR ANIMAL NUTRITION AND HEALTH

This invention relates to manufactured food articles, and to methods of inducing animals to eat such food articles.

Animals in captivity often are fed artificially-manufactured food. In many 5 circumstances, it is not feasible to feed the captive animals the naturally-occurring living plants or animals that they would normally eat in the wild. For example, fish that are grown in an aquaculture operation might normally eat other fish species in the wild, but it may be impractical to provide a large enough supply of the other species to supply the food needs of the aquaculture operation. Therefore, the fish are instead fed a manufactured food that 10 contains the necessary nutrients, for example in the form of pellets or flakes.

One problem with such artificially-manufactured food is that it is often less attractive, palatable, and/or digestible to the fish than the living things that they would normally eat in the wild. As a result, the fish may not readily eat the artificial food, and this reduction in food consumption can result in diminished growth rate or diminished overall health.

15 A long-standing need exists for artificial food items that will be readily eaten by animals.

### SUMMARY OF THE INVENTION

One embodiment of the present invention is an artificial, manufactured animal food article that comprises (a) at least one edible component selected from the group consisting of 20 animal nutritional materials, animal immune system stimulants, animal appetite stimulants, animal color enhancers, and animal therapeutic agents; and (b) a gel carrier matrix. The edible component is dispersed in the gel carrier matrix, which is also edible. The gel carrier matrix preferably forms a continuous phase throughout the food article, with the other components forming a discontinuous phase dispersed throughout the gel carrier matrix. The 25 food article can have the external shape of a naturally-occurring food item, either plant or animal, that would normally be eaten by an animal. This external appearance will make the article more attractive as food to an animal. For example, if the animal to be fed is a fish, the food article may have the external shape of a smaller fish, or a worm.

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In another embodiment of the invention, the food article has the scent or taste of a naturally-occurring food item that would normally be eaten by an animal. Thus, the animal to be fed will be attracted to this food article by sense of smell or taste.

In another embodiment of the invention, the specific gravity of the food article is 5 adjusted so as to cause the food article to exhibit approximately the same buoyancy in water as a naturally-occurring food item that would normally be eaten by the animal to be fed. For example, some fish typically feed on other living organisms that are usually found at the surface of the water in a natural habitat. If the food article has a specific gravity less than 1.0, the article will float and thus will appear at the same location in the aquatic environment as 10 the natural food of that fish species. Some other fish normally eat aquatic organisms that are found near the bottom of a body of water, while some others eat aquatic organisms that swim or float in a certain depth range beneath the surface. By modifying the specific gravity of the article to a desired value greater than 1.0, the article can be made to sink to or float at the desired depth.

15 Two or more of the characteristics of external shape, scent, color, and specific gravity can be combined in a single food article. For example, a single food article can be made that (a) has the same shape as a fish that normally swims near the surface, (b) exudes the scent of that fish, and (c) has a specific gravity that causes the article to float at or near the surface of the water.

20 Another embodiment of the invention is an artificial, manufactured animal food article that comprises at least one edible component as described above and a gel carrier matrix, with the edible component being dispersed in the gel carrier matrix as described above. In this embodiment of the invention, the food article has a pre-selected external shape that is other than a pellet shape or a flake shape. The food article can, for example, have the shape of an 25 animal, a plant, or a non-living ornamental article. This embodiment of the invention can have a shape that will appeal to human purchasers of the food articles, and need not necessarily appeal to the animals that will eat them. Pigmentation or other characteristics also can be added to these food articles to enhance their appeal to human purchasers.

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If an animal nutritional material is included in the food article, it can be a material such as a protein, carbohydrate, fat, or vitamin. If an animal immune system stimulant is to be included, it can be for example a yeast cell wall extract, with glucans being a preferred example. It is especially preferred that the immune system stimulant be primarily beta-1,3-glucan. "Primarily" in this context means that the immune system stimulant is a glucan that has more than about 50% (preferably more than about 75%, most preferably more than about 90%) beta-1,3-glycosidic linkages.

The proportions of the various components can vary, but in one preferred embodiment, more than about 50% by weight of the article is the edible gel carrier matrix (defined as the dry weight of the gelling agent (e.g., gelatin) plus the water that is added to form the gel). It is even more preferred for the gel carrier matrix to make up more than about 65% of the article.

Although the manufactured artificial food articles of the present invention could be used to feed humans (e.g., human infants), they are preferred for use in feeding non-human animals such as fish, crustaceans, companion animals (e.g., dogs, cats, birds), and the like. Such animals can see, smell, taste, or otherwise determine that the articles of the present invention resemble (either in appearance, scent, taste, or floating depth in water) a living thing (either animal or plant) that they are naturally attracted to as food. The animal may or may not be able to determine that the artificial food article is not in fact the naturally-occurring item that it looks like, smells like, or floats like, but in any event the similarity will make the animal more likely to eat the article. Alternatively, the shape can be chosen to appeal to a human purchaser of the article rather than to the animal that will eat the article.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a side view of an artificial food article in accordance with the present invention, in the shape of a fish.

Fig. 2 is a front view of the article of Fig. 1.

## DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

An artificial animal food article of the present invention can include one or more edible components that have some nutritional or health benefit for the animal that eats them, such as (a) animal nutritional materials, (b) animal immune system stimulants, (c) animal appetite stimulants, (d) animal color enhancers, and (e) animal therapeutic agents. Suitable animal nutritional materials include proteins (e.g., soy protein concentrate, shrimp meal, krill meal, krill hydrolysates), carbohydrates (e.g., wheat flour, alfalfa meal, corn gluten meal), fats (e.g., fish oil, soybean oil, sunflower oil), and vitamins (e.g., L-ascorbyl-2-polyphosphate, a source of Vitamin C, and deactivated animal sterol, a source of Vitamin D).  
The nutrient components of the food article can be either solid or liquid, and can be either water soluble or lipid soluble.

In one embodiment, the weight percentages of the various components in the overall food article are: gel carrier matrix (gelling agent plus water), about 50-90%; nutrients, about 5-45%; attractants (i.e., scent and/or taste providing agents), about 0.01-10%; preservatives, about 0-5%; immune system stimulants, about 0-0.5%; appetite stimulants, about 0-0.5%; color enhancers, about 0-0.5%; and therapeutic agents, about 0-3%.

It is preferable to include components that have the scent or taste of a naturally-occurring food that the subject animal normally eats and thus function as attractants for animals. For example, if the animal to be fed is a fish, the artificial food article can be provided with those chemicals responsible for the scent and/or taste of worms, insects, or the various other aquatic animals and/or plants that are attractive as food to the specific fish species that is involved. Fish meal and squid oil are suitable examples for inclusion in fish food. If the animal to be fed is a bird, the food article can for example have the shape, scent, and taste of various fruits, nuts, or seeds. If the animal to be fed is a cat, the food article can for example have the shape and scent of a fish, or the scent and taste of chicken. If the animal to be fed is a dog, the food article can for example have the shape and scent of a bone, or the scent and taste of beef. Suitable scent and/or taste-providing agents (i.e., chemo-attraction agents) include marine oils, marine solubles (e.g., byproducts of fish processing that contain trimethylglycine, and amino acids such as alanine, isoleucine, leucine, valine, and glycine).

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In general, substances having high glycine or alanine contents (or high contents of edible derivatives thereof such as trimethylglycine) are especially preferred. All of the characteristics (e.g., shape, scent, taste) can be adjusted for the particular species that will be eating the food. For example, in one particularly preferred embodiment of the invention, the 5 food article contains a mixture of fatty acids that comprise a fatty acid profile similar to that of the food which the animal has evolved eating. In other words, the fatty acid profile is one which that species of animal can digest reasonably well due to its similarity to the fatty acid profile in the food it normally eats.

Similarly, pigment can be added to the composition, to make the color of the 10 manufactured food article resemble food that the animal would eat in its natural habitat, or to appeal to a human buyer of the food article.

The composition can also include an animal appetite stimulant that acts on the animal's central nervous system, such as betaine.

The composition can also include animal color enhancers, such as astaxanthin and 15 leutin, which will enhance the coloration of the animal that eats the food article. For example, such color enhancers may enhance the scale coloration of a fish, or the coloration of the plumage of a bird.

Suitable animal immune system stimulants include glucans that are extracted from yeast cell walls. Beta-1,3-glucan is an especially preferred example, because it stimulates the 20 non-specific immune system of animals such as fish and mammals, making the animals to which it is administered or fed more resistant to stress and bacterial, fungal, and viral infections. One particular product that contains beta-1,3-glucan is ImmuStim, available from ImmuDyne, Inc., Fort Pierce, Florida. Other suitable immune system stimulants include chitin and echinacea. These substances interact with certain receptor sites on cells such as 25 macrophages, eliciting responses from the animal's immune and endocrine systems, resulting in higher levels of pigmentation, growth, and survival than would otherwise be achieved.

Suitable animal therapeutic agents include antibiotics such as tetracycline, oxytetracycline, ampicillin, and gentamycin.

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The composition can also include nutrient transport agents or nutrient carrier molecules. Substances such as poly- or oligosaccharides, hydrolyzed marine proteins, and certain nutrients products will improve transport of certain vitamins, minerals, and pigments across the digestive system cell membranes. Alternatively, such transport-enhancing agents 5 can be released as a result of activation of certain receptor sites of specific cells by the immune system stimulator. The composition can suitably contain nutrients that are tailored to be transported in vivo by the agents that are released in vivo as a result of the immune system stimulants.

Preservatives can also be included. Propylene glycol and propionic acid are suitable 10 examples.

The above ingredients are dispersed in an edible gel carrier matrix-forming agent. Suitable gelling agents include gum arabic, ghatti, tragacanth, guar, locust bean gum, agar, algin, carrageenan, pectin, chitin, gelatin, amylose, amylopectin, and bacterial gels. In contrast to compositions which are coated with a gel, the present invention employs a gel 15 matrix as a integral part of the entire food article. The gel matrix preferably forms a continuous phase, with the nutritional materials and other ingredients forming a discontinuous dispersed phase in the continuous gel phase.

The ingredients of the composition can be combined, preferably by mixing in water that is heated sufficiently to form the gel, and can then be extruded, molded, or cut into the 20 desired shapes (for example, into the shape of a plant, insect, crustacean, reptile, amphibian, or fish) by means that are well known in this field. The resulting gelled composition will typically be semi-solid. It should not require refrigeration during storage.

The ability to form the product into any desired shape also provides potential marketing benefits with respect to the humans who will buy the food for animals. The color, 25 shape, and the like of the food articles can be selected so as to appeal to the human purchaser in addition to appealing to the non-human animal that will eat the article.

After the manufacturing is completed, the artificial food articles can be fed to an animal in an amount that can be readily determined by a person of ordinary skill. If beta-1,3-

glucan is included in the article, it is preferably included at a concentration that will provide a dosage to the animal that eats the article of between about 0.5-1.0 g/kg of feed eaten.

The gel matrix provides the manufactured food article with a flesh-like texture that is generally acceptable to various animals and thus provides tactile attraction, in contrast to hard 5 pellets which have commonly been used as animal food in the past.

While manufacturing the composition, a component having a low specific gravity can be added to provide a controlled specific gravity for the overall product and thus to control its buoyancy in water. Many aquatic and marine animals have specific areas or zones within the water column in which they feed. For example, carp, catfish, and goatfish are bottom feeders, 10 tetras and clownfish are mid-water feeders, and hatchet fish and guppies are top feeders. One particularly preferred ingredient for providing the desired specific gravity is albumin (egg white). This is preferably added near the end of the mixing process.

One example of a manufactured food article in accordance with the present invention is shown in Figs. 1 and 2. Fig 1 shows a side view and Fig. 2 a front view of a food article 10 formed in the shape of a fish, having a plurality of fins 12, 14, and 16 as would a real fish.

The food article 10 consists largely of the gel matrix 18. Interspersed throughout the gel matrix 18 are particles 20 of various edible materials such as nutrients. Although the particles are shown in Fig. 1 as visible to the naked eye, it should be understood that those particles might instead be small enough that they could not be seen readily. Further, the particles 20 need not all be of uniform size. In addition, if pigmentation is included in the composition, the particles may not be externally visible even if they are large enough to be seen.

In an alternative embodiment, the food article can have the form of seaweed that is commonly eaten by fish, and can optionally be bonded to an anchoring device (e.g., a chunk of calcium carbonate) to hold it on the bottom of an enclosure of water in which fish are kept.

25 The invention can be further understood from the following example.

*Example 1*

A tropical fish food composition contains the ingredients shown in Table 1.

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Table 1

<i>ingredient</i>	<i>weight percent</i>
Water	64.00
Gelatin	7.27
Soy protein concentrate	6.50
Squid oil	3.00
Krill hydrolysates	1.9295
Dehydrated alfalfa meal	1.50
Wheat flour	1.40
Krill meal	1.40
Shrimp meal	1.30
Alginate	1.30
Dried skim milk	1.50
Brewer's yeast	1.50
Fish oil	1.50
Preservative (Ethoxiquin)	1.00
Corn gluten meal	0.70
Spinach powder	0.525
Kelp meal	0.525
Soybean oil	0.525
Phaffia rhodozyme	0.525
Vitamin mix (e.g., vitamin C)	0.5075
Coconut oil	0.35
Spirulina	0.35
Dried red bell pepper	0.35
Calcium chloride	0.35
Chromophyll (marigold petals)	0.175
Carophyll	0.0175
Beta-1,3-glucan (ImmuStim)	0.0005

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The gelatin is dissolved in boiling water. The oils are then added. Optionally, protein coated foam (albumin) can be added to modify the specific gravity and therefore the buoyancy of the composition. With the temperature at 170°F, the remaining ingredients are added, preferably in the form of finely ground dry particles. The composition is then mixed 5 thoroughly. It can be extruded or molded into the desired shapes.

The preceding description of specific embodiments of the present invention is not intended to limit the scope or be a complete list of every possible embodiment of the invention. Persons skilled in this field will recognize that modifications can be made to the specific embodiments described here that would be within the scope of the present invention.

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**CLAIMS:**

1. A manufactured animal food article, comprising:  
at least one edible component selected from the group consisting of animal nutritional  
materials, animal immune system stimulants, animal appetite stimulants,  
5 animal color enhancers, and animal therapeutic agents;  
the edible component being dispersed in an edible gel carrier matrix;  
where the food article has the external shape of a naturally-occurring food item that is  
eaten by an animal.
2. The animal food article of claim 1, where the food article has the external shape of an  
10 animal that is eaten by another animal.
3. The animal food article of claim 1, where the animal nutritional material is selected  
from the group consisting of proteins, carbohydrates, fats, vitamins, and minerals.
4. The animal food article of claim 1, where the animal immune system stimulant is a  
yeast cell wall extract.
- 15 5. The animal food article of claim 1, where the animal immune system stimulant is a  
glucan.
6. The animal food article of claim 1, where the animal immune system stimulant is  
primarily beta-1,3-glucan.
7. The animal food article of claim 1, where the edible gel carrier matrix forms a  
20 continuous phase throughout the animal food article, with the other components forming a  
discontinuous phase dispersed throughout the gel carrier matrix.
8. The animal food article of claim 1, where more than about 50% by weight of the  
article is the edible gel carrier matrix.
9. The animal food article of claim 1, where the food article has the scent or taste of a  
25 naturally-occurring food item that is eaten by an animal.

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10. The animal food article of claim 1, where the specific gravity of the food article is adjusted so as to cause the food article to exhibit approximately the same buoyancy in water as a naturally-occurring food item that is eaten by an animal.

11. A manufactured animal food article, comprising:

5 at least one edible component selected from the group consisting of animal nutritional materials, animal immune systems stimulants, animal appetite stimulants, animal color enhancers, and animal therapeutic agents; the edible component being dispersed in an edible gel carrier matrix; where the food article has the scent or taste of a naturally-occurring food item that is  
10 eaten by an animal.

12. The animal food article of claim 11, where the food article has the external shape of an animal that is eaten by another animal.

13. The animal food article of claim 11, where the animal nutritional material is selected from the group consisting of proteins, carbohydrates, fats, vitamins, and minerals.

15 14. The animal food article of claim 11, where the animal immune system stimulant is a yeast cell wall extract.

15. The animal food article of claim 11, where the animal immune system stimulant is a glucan.

16. The animal food article of claim 11, where the animal immune system stimulant is primarily beta-1,3-glucan.  
20

17. The animal food article of claim 11, where the edible gel carrier matrix forms a continuous phase throughout the animal food article, with the other components forming a discontinuous phase dispersed throughout the gel carrier matrix.

18. The animal food article of claim 11, where more than about 50% by weight of the  
25 article is the edible gel carrier matrix.

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19. The animal food article of claim 11, where the food article has the external shape of a naturally-occurring food item that is eaten by an animal.
20. The animal food article of claim 11, where the specific gravity of the food article is adjusted so as to cause the food article to exhibit approximately the same buoyancy in water as a naturally-occurring food item that is eaten by an animal.  
5
21. A manufactured animal food article, comprising:
  - at least one edible component selected from the group consisting of animal nutritional materials, animal immune systems stimulants, animal appetite stimulants, animal color enhancers, and animal therapeutic agents;
  - 10 the edible component being dispersed in an edible gel carrier matrix;
  - where the specific gravity of the food article is adjusted so as to cause the food article to exhibit approximately the same buoyancy in water as a naturally-occurring food item that is eaten by an animal.
22. The animal food article of claim 21, where the food article has the external shape of  
15 an animal that is eaten by another animal.
23. The animal food article of claim 21, where the animal nutritional material is selected from the group consisting of proteins, carbohydrates, fats, vitamins, and minerals.
24. The animal food article of claim 21, where the animal immune system stimulant is a yeast cell wall extract.  
20
25. The animal food article of claim 21, where the animal immune system stimulant is a glucan.
26. The animal food article of claim 21, where the animal immune system stimulant is primarily beta-1,3-glucan.

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27. The animal food article of claim 21, where the edible gel carrier matrix forms a continuous phase throughout the animal food article, with the other components forming a discontinuous phase dispersed throughout the gel carrier matrix.
28. The animal food article of claim 21, where more than about 50% by weight of the article is the edible gel carrier matrix.  
5
29. The animal food article of claim 21, where the food article has the external shape of a naturally-occurring food item that is eaten by an animal.
30. The animal food article of claim 21, where the food article has the scent of a naturally-occurring food item that is eaten by an animal.  
10
31. A manufactured animal food article, comprising:  
at least one edible component selected from the group consisting of animal nutritional materials, animal immune system stimulants, animal appetite stimulants, animal color enhancers, and animal therapeutic agents;  
the edible component being dispersed in an edible gel carrier matrix;  
15 where the food article has a pre-selected external shape that is other than a pellet shape or a flake shape.
32. The animal food article of claim 31, where the food article has the external shape of an animal.  
20
33. The animal food article of claim 31, where the food article has the external shape of a plant.
34. The animal food article of claim 31, where the food article has the external shape of an ornamental article.  
25

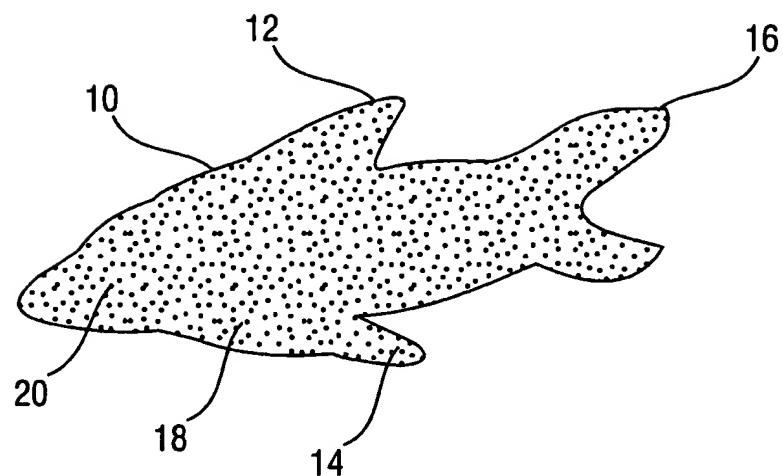


FIG. 1

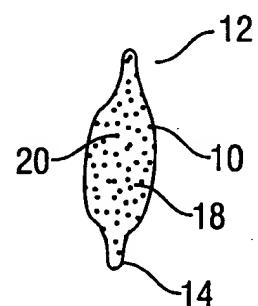


FIG. 2

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US98/04499

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(6) : A23L 1/0532  
 US CL : 424/442, 499, 817, 827; 426/72, 74, 250, 573, 635, 656, 658, 805  
 According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 424/442, 499, 817, 827; 426/72, 74, 250, 573, 635, 656, 658, 805

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
 NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
 NONE

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ----	US, 5,525,353 A (FAJT) 11 June 1996 (11-06-96), see entire document.	21,23,27, 28 -----
Y		1-20,22,24-26,29-34
Y	US 5,401,727 A (RORSTAD et al.) 28 March 1995 (28-03-95), see entire document.	4-6,14-16, 24-26
Y	US 5,169,634 A (ELLINGSEN et al.) 08 December 1992 (08-12-92), see entire document.	9,11-20,30
Y	US 3,899,480 A (KIMURA et al.) 12 August 1975 (12-08-75), see entire document.	1-10, 12, 19, 22, 29, 31-34

Further documents are listed in the continuation of Box C.  See patent family annex.

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